two other vessels, which are continued on each side of the stomach as far as the siphon, and are united here and there by transverse anastomoses, on both the dorsal and ventral surfaces. Moreover the vessel which skirts the right border of the stomach * furnishes several small vessels which ramify over the mesenteric lamella extending from the diverticulum to the digestive tube. All these vessels afterwards unite in one trunk, which follows the diverticulum to the heart, between the sand-canal and the marginal vessel of the diverticulum, giving off to the right and left transverse branches, which place it in communication at once with the sand-canal and this marginal vessel.—*Comptes Rendus,* October 24, 1881, p. 651.

Jurassic Birds and their Allies. By Prof. O. C. Marsh†.

About twenty years ago, two fossil animals of great interest were found in the lithographic slates of Bavaria. One was the skeleton of *Archæopteryx*, now in the British Museum; and the other was the *Compsognathus* preserved in the Royal Museum at Munich. A single feather, to which the name *Archæopteryx* was first applied by Von Meyer, had previously been discovered at the same locality. More recently, another skeleton has been brought to light in the same beds, and is now in the Museum of Berlin. These three specimens of *Archæopteryx* are the only remains of this genus known, while of *Compsognathus* the original skeleton is, up to the present time, the only representative.

When these two animals were first discovered, they were both considered to be reptiles by Wagner, who described *Compsognathus*; and this view has been held by various authors down to the present time. The best authorities, however, now agree with Owen that *Archæopteryx* is a bird, and that *Compsognathus*, as Gegenbaur and Huxley have shown, is a Dinosaurian reptile.

Having been engaged for several years in the investigation of American Mesozoic birds, it became important for me to study the European forms; and I have recently examined with some care the three known specimens of *Archæopteryx*. I have also studied in the continental museums various fossil reptiles, including *Compsognathus*, which promised to throw light on the early forms of birds.

During my investigation of *Archæopteryx*, I observed several characters of importance not previously determined; and I have thought it might be appropriate to present them here. The more important of these characters are as follows:—

1. The presence of true teeth, in position, in the skull.
2. Vertebræ biconcave.
3. A well-ossified, broad sternum.
4. Three digits only in the manus, all with claws.
5. Pelvic bones separate.
6. The distal end of fibula in front of tibia.

* The animal supposed to be placed on the ventral surface.

† Read before Section D, British Association for the Advancement of Science, at York, Sept. 2, 1881.

7. Metatarsals separate or imperfectly united.

These characters, taken in connexion with the free metacarpals and long tails, previously described, show clearly that we have in *Archæopteryx* a most remarkable form, which, if a bird (as I believe), is certainly the most reptilian of birds.

If now we examine these various characters in detail, their importance will be apparent.

The teeth actually in position in the skull appear to be in the premaxillary, as they are below or in front of the nasal aperture. The form of the teeth, both crown and root, is very similar to that of the teeth of *Hesperornis*. The fact that some teeth are scattered about near the jaw would suggest that they were implanted in a groove. No teeth are known from the lower jaw; but they were probably present.

The presacral vertebræ are all, or nearly all, biconcave, resembling those of *Ichthyornis* in general form, but without the large lateral foramina. There appear to be twenty-one presacral vertebræ, and the same, or nearly the same, number of caudals. The sacral vertebræ are fewer in number than in any known bird, those united together not exceeding five, and probably less.

The scapular arch strongly resembles that of modern birds. The articulation of the scapula and coracoid, and of the latter with the sternum, is characteristic; and the furcula is distinctly avian. The sternum is a single broad plate, well ossified. It probably supported a keel; but this is not exposed in the known specimens.

In the wing itself the main interest centres in the manus and its free metacarpals. In form and position these three bones are just what may be seen in some young birds of today. This is an important point, as it has been claimed that the hand of *Archæopteryx* is not at all avian, but reptilian. The bones of the reptile are indeed there; but they have already received the stamp of the bird.

One of the most interesting points determined during my investigation of *Archæopteryx* was the separate condition of the pelvic bones. In all other known adult birds, recent and extinct, the three pelvic elements, ilium, ischium, and pubis, are firmly ankylosed. In young birds these bones are separate; and in all known Dinosaurian reptiles they are also distinct. This point may perhaps be made clearer by referring to the two diagrams before you, which I owe to the kindness of my friend Dr. Woodward, of the British Museum, who also gave me excellent facilities for examining the *Archæopteryx* under his care. In the first diagram we have represented the pelvis of an American Jurassic Dinosaur allied to *Iguanodon*; and here the pelvic bones are distinct. The second diagram is an enlarged view of the pelvis of the *Archæopteryx* in the British Museum; and here too the ilium is seen separate from the ischium and pubis.

In birds the fibula is usually incomplete below; but it may be coossified with the side of the tibia. In the typical Dinosaurs (*Iguanodon*, for example) the fibula at its distal end stands in front

of the tibia; and this is exactly its position in *Archæopteryx*, an interesting point not before seen in birds.

The metatarsal bones of *Archæopteryx* show, on the outer face at least, deep grooves between the three elements, which imply that the latter are distinct, or unite late together. The free metacarpal and separate pelvic bones would also suggest distinct metatarsals, although they naturally would be placed closely together, so as to appear connate.

Among other points of interest in *Archæopteryx* may be mentioned the brain-cast, which shows that the brain, although comparatively small, was like that of a bird, and not that of a Dinosaurian reptile. It resembles in form the brain-cast of *Laopteryx*, an American Jurassic bird, which I have recently described. The brain in both these birds appears to have been of a somewhat higher grade than that of *Hesperornis*; but this may have been due to the fact that the latter was an aquatic form, while the Jurassic species were land birds.

As the Dinosauria are now generally considered the nearest allies to birds, it was interesting to find in those investigated many points of resemblance to the latter class. *Compsognathus*, for example, shows in its extremities a striking similarity to *Archæopteryx*. The three-clawed digits of the manus correspond closely with those of that genus, although the bones are of different proportions. The hind feet also have essentially the same structure in both. The vertebræ, however, and the pelvic bones of *Compsognathus* differ materially from those of *Archæopteryx*; and the two forms are in reality widely separated. While examining the *Compsognathus* skeleton, I detected in the abdominal cavity the remains of a small reptile which had not been previously observed. The size and position of this enclosed skeleton would imply that it was a fœtus; but it may possibly have been the young of the same species, or an allied form that had been swallowed. No similar instance is known among the Dinosaurs.

A point of resemblance of some importance between birds and Dinosaurs is the clavicle. All birds have those bones; but they have been considered wanting in Dinosaurs. Two specimens of *Iguanodon* in the British Museum, however, show that these elements of the pectoral arch are present in that genus. Some other Dinosauria possess clavicles; but in several families of this subclass, as I regard it, they appear to be wanting.

The nearest approach to birds now known would seem to be in the very small Dinosaurs from the American Jurassic. In some of these the separate bones of the skeleton cannot be distinguished with certainty from those of Jurassic birds, if the skull is wanting; and even in this part the resemblance is striking. Some of these diminutive Dinosaurs were perhaps arboreal in habit; and the difference between them and the birds that lived with them may have been at first mainly one of feathers, as I have shown in my memoir on the Odontornithes, published during the past year.

It is an interesting fact that all the Jurassic birds known, both

from Europe and America, are land birds, while all from the Cretaceous are aquatic forms. The four oldest known birds, moreover, differ more widely from each other than do any two recent birds. These facts show that we may hope for most important discoveries in the future, especially from the Triassic, which has as yet furnished no authentic trace of birds. For the primitive forms of this class we must evidently look to the Palæozoic.—*Amer. Journ. Science*, Nov. 1881, pp. 337–340.

Contributions to the Natural History of the Compound Ascidia of the Bay of Naples. By Dr. A. Della Valle.

The author in the first place carefully describes his genus *Distaplia*. In this genus the colony is pedunculate or sessile; the individuals, arranged in branched cœnobia, have the form of Didemnidæ with an ectodermic process. The branchial sac is furnished with four series of fissures; the stomach has smooth walls; the heart is placed at the level of the intestinal loop; the sexual glands are situated on the right side and rather above the heart. The testis is developed before the ovary, and in all the individuals of the colony at the same time, so that the colonies are always formed entirely of male or of female individuals. The mature ova are collected in the cloaca, whence they fall into a peculiar diverticulum, which is developed for this purpose and afterwards separates from the animal. The larvæ are gigantic, and already produce buds. The formation of a new bud commences by eversion of the parietal lamella of the peritoneal sac at a short distance from the end of the endostyle. The bud very soon separates from the maternal individual, and migrates towards the peripheral parts, dividing by scission, and thus giving origin to new individuals, which increase the colony.

In connexion with the structure of the tail of this large larva the author gives an account of the observations of other writers on the axial cord which is seen in the tail of these larvæ, and shows, by means of transverse sections, that this cord, considered by Kowalevsky, Kupffer, &c. to be formed of solid gelatinous material, is, instead, merely a cylindrical canal full of a transparent and colourless liquid, which is perhaps the same liquid that bathes the surrounding cellular elements.

The author then proceeds to the exposition of his anatomical researches. He has observed that in the living ectoderm amœboid cells move about in the common mantle, thus confirming a previous observation of Hertwig's. He describes very carefully the general structure of an ascidiozooid, which he finds to be formed of an internal endodermic sac and of a bilobed peritoneal sac, interposed between the two primary sacs. The peritoneal sac communicates on the one hand with the endoderm by means of the branchial fissures, and on the other with the exterior by the cloacal siphon. The muscular fibres are situated between the parietal lamella of the peritoneum and the ectoderm. The heart and the sexual glands